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IS : 4774 (Part I) - 1982
(Reaffirmed 2005)
Edition 2.1
(1996-02)

UDC 621.822.5 : 621-12

Indian Standard

SPECIFICATION FOR THIN-WALLED HALF BEARING

PART I PLAIN BEARING

(First Revision)

(Incorporating Amendment No. 1)

Plain Bearing Sectional Committee, EDC 80 [Ref : Doc : EDC 80 (3183)]

1. Scope — Covers requirements for thin-walled half bearings used in reciprocating machinery and suitable for housings having inside diameters from 20 to 200 mm.

2. Material — The linings of the steel-backed bearing half-liners shall be of materials suitable for the purpose. Some typical compositions of lining materials are given in Appendix A and B for information. At least one sample shall be checked from each lot for chemical composition.

2.1 *Lining Thickness* — For better fatigue strength, it is desirable to provide minimum bearing alloy lining thickness on steel backings. The following are the minimum lining thicknesses recommended for different lining materials.

a) White metal (nonmicro)	0.125 mm
b) White metal (micro)	0.05 mm
c) Copper-lead	0.125 mm
d) Tin-aluminium	0.125 mm

2.2 *Adherence Test* — This test shall be carried out to ensure that the bearing metal is completely and firmly bonded to the backing metal. For conducting this test, unless otherwise specified by the purchaser, at least one bearing shall be taken from each lot. The test shall be carried out as follows:

> The grooves in the bearing-metal liner parallel to the longitudinal axis of the bearing shall be cut with a chisel. The grooves shall be cut to the full depth of the bearing-metal liner and shall be so spaced as to leave lands of bearing metal approximately 6 mm wide. The chisel shall than be inserted at right angles to the bearing-metal lands at the bond line and the liner cut away along the bond line. This operation shall be repeated at intervals along the lands to determine if there is any tendency for the lining to separate cleanly and as a unit from the backing metal. The inside surface of the backing metal shall be examined and any evidence of poor bonding shall be a cause for the rejection of the lot represented.

2.3 *Microstructure* — At least one sample from each lot shall be checked for microstructure to ensure that there is no flaw in bearing material.

3. Dimension — The basic nominal dimension of housing (internal) diameter, inside diameter and wall thickness shall be as given in Table 1.

4. Tolerances

4.1 *Housing Diameter* — Ferrous housings shall be manufactured to H6 limits [*see* IS : 919 (Part I)-1963 Recommendations for limits and fits for engineering: Part I General engineering], but in the case of housings made from materials having a high coefficient of expansion, or where other factors such as housing dimensional stability are involved, the housing size may depart from H6 limits but shall always be produced in accordance with a grade 6 tolerance.

4.2 *Peripheral Length* (*Crush*) — The peripheral length shall be measured by use of the checking method given in **6**.

Note 1 — The bearings covered under this standard are thin and flexible and their outside diameters may not be measured by conventional means.

Note 2 — It is not possible to specify the actual size of peripheral length in this standard, since it will be dependent upon the precise application. (For example, housing rigidity and material, operating temperature, bearing material and other factors have to be taken into account. This may be determined for each individual application.)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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TABLE 1 HOUSING DIAMETER, INSIDE DIAMETERS AND WALL THICKNESS

(*Clause* 3)

All dimensions in millimetres.

Preferred Housing Diameters D_1	Inside Diameters, for Wall Thickness							
	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0
20	17	16.5						
21	18	17.5						
22	19	18.5						
24	21	20.5						
25	22	21.5						
26	23	22.5						
28	25	24.5						
30	27	26.5						
32	29	28.5	28					
34	31	30.5	30					
36	33	32.5	32					
38	35	34.5	34					
40		36.5	36	35				
42		38.5	38	37				
45		41.5	41	40				
48		44.5	44	43				
50		46.5	46	45				
53		49.5	49	48				
56		52.5	52	51				
60		56.5	56	55				
63		59.5	59	58				
67			63	62	61			
71			67	66	65			
75			71	70	69			
80			76	75	74			
85			81	80	79			
90				85	84	83		
95				90	89	88		
100				95	94	93		
105				100	99	98		
110				105	104	103		
120				115	114	113		
125					119	118	117	
130					124	123	122	
140					134	133	132	
150					144	143	142	
160					154	153	152	
170						163	162	160
180						173	172	170
190						183	182	180
200						193	192	190

4.2.1 For machined bearings, the manufacturing tolerances on peripheral length shall be in accordance with the values of the tolerance on measured nip, S_n (*see* Fig. 8) given in Table 2.

TABLE 2 TOLERANCE ON MEASURED NIP

(*Clause* 4.2.1 *and* Fig. 8)

All dimensions in millimetres.

Housing Diameter D_L		**Tolerance on** S_n (S_n *Max* - S_n *Min*)
Above	Up to and Including	
—	75	0.038
75	120	0.045
120	200	0.050

4.3 *Wall Thickness* — The tolerance on wall thickness e_T will depend upon whether the bearing inside diameter is subject to a final machining operation (that is 'as machined') or whether its inside bearing surface is electroplated (that is 'as plated'). The relevant tolerances shall be as given in Table 3.

TABLE 3 WALL THICKNESS TOLERANCE

All dimensions in millimetres.

Housing Diameter D_L		**Tolerance on** e_T (e_T *Max* - e_T *Min*)	
Above	Up to and Including	As Machined	As Plated
—	75	0.008	0.012
75	100	0.010	0.014
100	120	0.012	0.016
120	200	0.017	0.024

Note — Slight surface depressions are acceptable on the outside diameter of the bearings, provided that they are randomly distributed. However, the measurement of wall thickness shall not be carried out in these areas.

4.4 *Bearing Width* — This standard does not specify bearing width *L*, since this feature will be determined by the application. The tolerance on width as given in Table 4 shall apply for various inside diameters of thin-walled half bearings.

TABLE 4 BEARING WIDTH TOLERANCE

All dimensions in millimetres.

Inside Diameter		**Tolerance on** L
Above	Up to and Including	
20	120	± 0.13
120	200	± 0.20

4.5 *Surface Finish*

4.5.1 The surface finish in the bore shall be of roughness grade number N6 (*see* IS : 3073-1967 Assessment of surface roughness).

4.5.1.1 In case of overlay plated bearings, the surface finish shall be measured before plating and the limits as above shall be applied.

4.5.1.2 At last one bearing shall be checked for surface finish from each lot.

4.5.2 *Backing* — Surface finish of the back of steel-backed bearings shall be as given in Table 5.

TABLE 5 SURFACE FINISH OF THE BACK OF STEEL-BACKED BEARING

Housing Diameter D_L		Surface Finish µm
Above	Up to and Including	
—	120	0.8
120	200	1.2

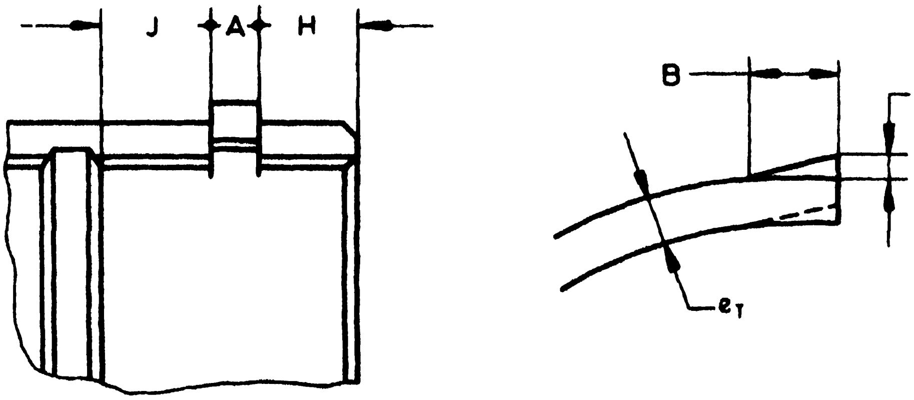
4.5.3 *Journal/Shaft* — The surface finish for the journal/shaft shall be of roughness grade number N5 (*see* IS : 3073-1967).

4.6 *Free Spread* — Free spread is influenced by factors such as the lining material and its physical properties, backing material and its physical properties, and the operating temperature of the assembly. However, free spread shall remain positive and shall be such that, after operation on the engine at normal conditions, a sufficient amount of free spread remains in the bearing to enable it to be refitted.

4.6.1 For guidance only, automotive and small diesel engine bearings up to 120 mm housing diameter, normally have free spread falling in the range of 0.2 to 2 mm depending upon the size and material being used. For larger bearings, free spread shall normally be greater for any given rigidity (ratio of e_T nominal and D_L nominal) of the bearings and for more rigid bearing it shall normally be less for any given nominal diameter of bearings. Care shall be taken that the free spread is not such that it prevents the bearings being assembled. The actual amount of free spread shall be subject of agreement between the manufacturer and the user.

5. Constructional Features

5.1 *Locating Nicks and Notch Recesses* — When nicks are used for location, the dimensions and tolerances of the locating nick and the notch in the housing shall be as shown in Fig. 1 and 2 and Tables 6, 7 and 8.



H — The nick may be produced at the end of the bearing, in which case $H = 0$.
Otherwise, $H > 1{\cdot}5 \times e_T$, but shall be not less than 3 mm.

J — The nick shall be permitted to break into the groove, in which case $J = 0$. Otherwise, $J > 2$ mm.

FIG. 1 LOCATING NICK

TABLE 6 DIMENSIONS FOR LOCATING NICK

(*Clause* 5.1 *and* Fig. 1)

All dimensions in millimetres.

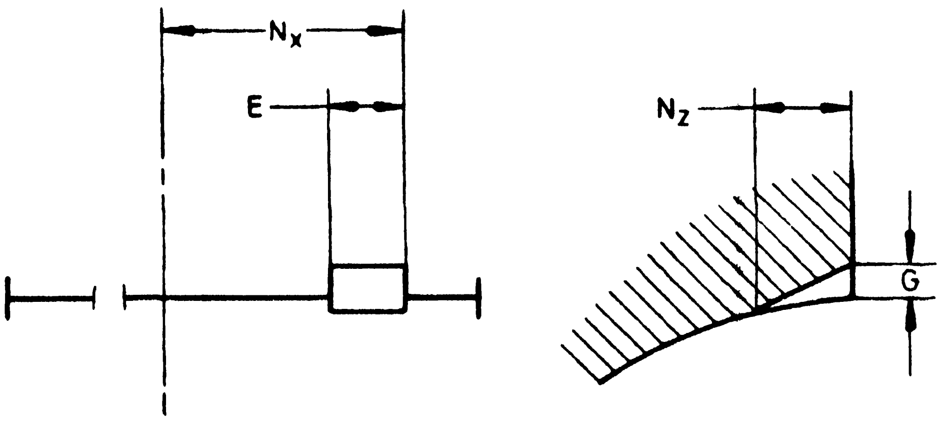
Housing Diameter D_L		A	B	N_D
Above	Up to and Including			
—	38	2.72 to 2.84	3.0 to 4.0	0.8 to 1.1
38	63	3.72 to 3.84	5.0 to 6.0	1.0 to 1.3
63	85	4.67 to 4.81	5.0 to 6.0	1.2 to 1.5
85	120	5.67 to 5.81	6.0 to 7.0	1.4 to 1.7
120	200	7.61 to 7.71	8.5 to 10.0	1.5 to 2.0

TABLE 7 TOLERANCE ON DIMENSION *H*

(*Clause* 5.1 *and* Fig. 1)

All dimensions in millimetres.

Housing Diameter D_L		**Tolerance on *H***
Above	Up to and Including	
—	120	± 0.15 0
120	200	± 0.20 0



$N_X = \frac{L}{2} - H$ *Min*

Tol on N_X $+^{0.13}_{0}$ mm

FIG. 2 NOTCH IN HOUSINGS

TABLE 8 DIMENSIONS FOR NOTCH IN HOUSING

(*Clause* 5.1 *and* Fig. 2)

All dimensions in millimetres.

Housing Diameter D_L		E	N_Z	G
Above	Up to and Including			
—	38	3.06 to 2.94	5.5 to 4.5	1.75 to 1.50
38	63	4.56 to 3.94	8.5 to 7.0	2.15 to 1.75
63	85	5.07 to 4.93	10.0 to 8.0	2.61 to 2.00
85	120	6.07 to 5.93	12.0 to 9.0	3.00 to 2.25
120	200	8.08 to 7.92	15.5 to 12.0	4.00 to 3.00

5.2 *Joint Face Bore Relief* — These are usually provided in thin-walled half bearings, although they may be omitted in certain cases of bearings for oblique split connecting rods.

5.2.1 Joint face bore reliefs are provided at both sides of thin-walled half bearings on the whole width. The relevant dimensions shall be as given in Table 9 and Fig. 3.

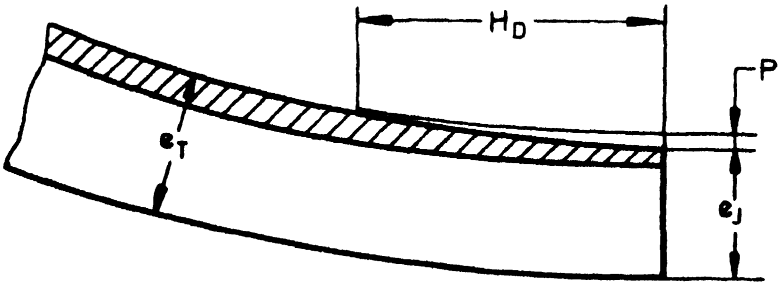


FIG. 3 JOINT FACE BORE RELIEF

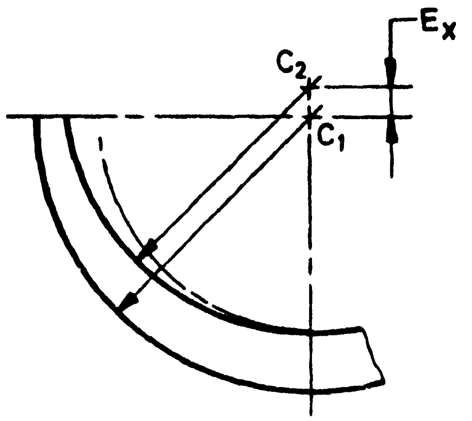
TABLE 9 DIMENSIONS AND TOLERANCES FOR RELIEF

All dimensions in millimetres.

Housing Diameter D_L		Tolerance on H_D	$P_D = e_T - e_J$
Above	Up to and Including		
—	38	0 −2	0.037 to 0.012
38	63	0 −3	
63	85	0 −3	
85	120	0 −4	
120	200	0 −5	0.045 to 0.20

5.2.2 For guidance, it is suggested that dimension H_D be 1/7 of the bore diameter, but the actual value of this dimension will depend upon the application and shall be subject to agreement between the user and the manufacturer.

5.3 *Eccentric Bores* — In certain applications, it may be necessary to use bearings having eccentric, bores that is where the wall thickness of the bearings decreases uniformly from the crown to the joint faces (*see* Fig. 4).



Note 1 — Eccentricity E_x — It is characterized in a radial plane by the distance between the centre C_1 of the bearing outside surface and the centre C_2 of the bearing bore.

Note 2 — Tolerance on E_x — Converted into wall thickness variation in order to check it easily on finished bearings. It should be subject to agreement between the user and the manufacturer.

FIG. 4 ECCENTRIC BORE

5.3.1 Ecccentric bores are not generally required in bearings larger than 120 mm housing diameter.

5.4 *Oil Grooves* — Groove sizes are determined by functional requirements and are not specified in this standard.

5.4.1 *Groove forms* — The preferred groove forms are shown in Fig. 5.

5.4.2 *Groove location* — For a central annular groove, the position shall be specified as indicated in Fig. 6. The value of symmetry tolerance shall be stated in the second compartment of the tolerance frame.

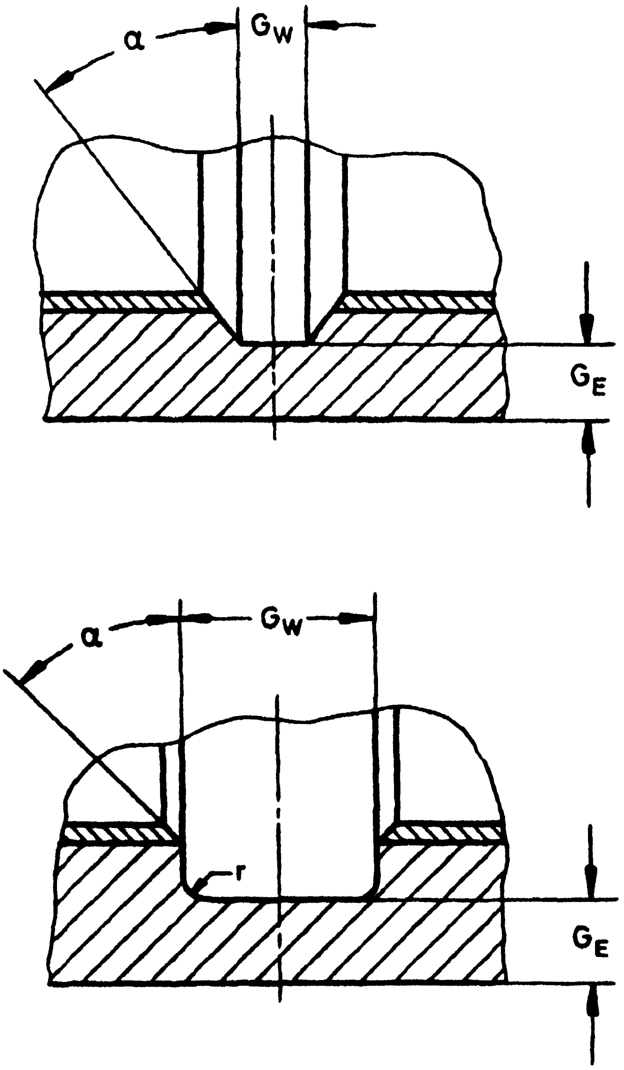
Drain grooves shall be 3 mm minimum from edge of groove to chamfer at the end of bearings.

5.4.3 *Groove depth* — The wall thickness at the back of groove G_E shall not be less than 0.7 mm or 0.35 × e_T, whichever is larger.

5.4.3.1 The tolerances on the wall thickness at the back of groove shall be as given in Table 10.

5.5 *Oil Holes* — Oil holes shall usually be drilled, but may also be pierced. In both cases, the sharp edges of oil holes shall be removed.

5.5.1 For centrally positioned oil holes, tolerance shall be specified as indicated in Table 11 (*see* Fig. 7). For all other cases, the positions of oil holes shall be subject to agreement between the user and the manufacturer.



r = Chamfer radius, to be specified;
G_W = Groove width, to be specified; and
G_E = Wall thickness at back of groove, to be specified;
Angles of α = 30° and 45° are most frequently used.

FIG. 5 GROOVE FORMS

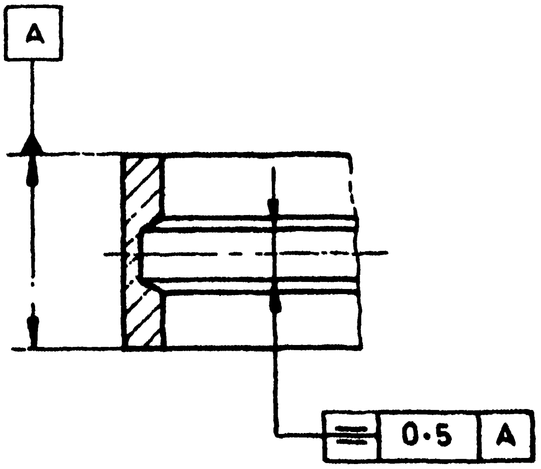


FIG. 6 SYMMETRY TOLERANCE ON GROOVES

TABLE 10 TOLERANCE ON WALL THICKNESS AT BACK GROOVE

(*Clause* 5.4.3.1 *and* Fig. 5)

All dimensions in millimetres.

Housing Diameter D_L		Tolerance on G_E
Above	Up to and Including	
—	120	+ 0.25 0
120	200	+ 0.35 0

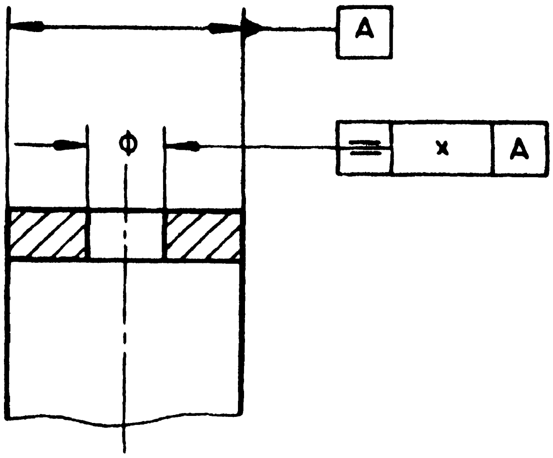


FIG. 7 SYMMETRY TOLERANCE ON OIL HOLES

TABLE 11 SYMMETRY TOLERANCE

(*Clause* 5.5.1 *and* Fig. 7)

All dimensions in millimetres.

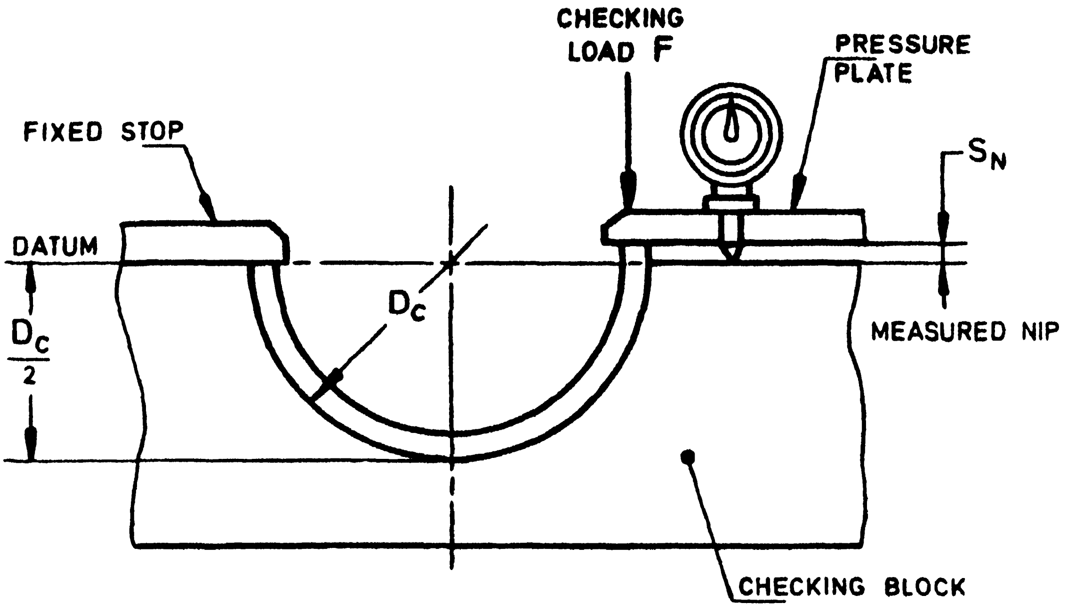
Bearing Width L		Symmetry Tolerance X
Above	Up to and Including	
20	120	0.5
120	200	1.00

5.5.1.1 The tolerance for the angular location of oil holes shall be ± 1° and that for oil hole diameter shall be ± 0.25 mm.

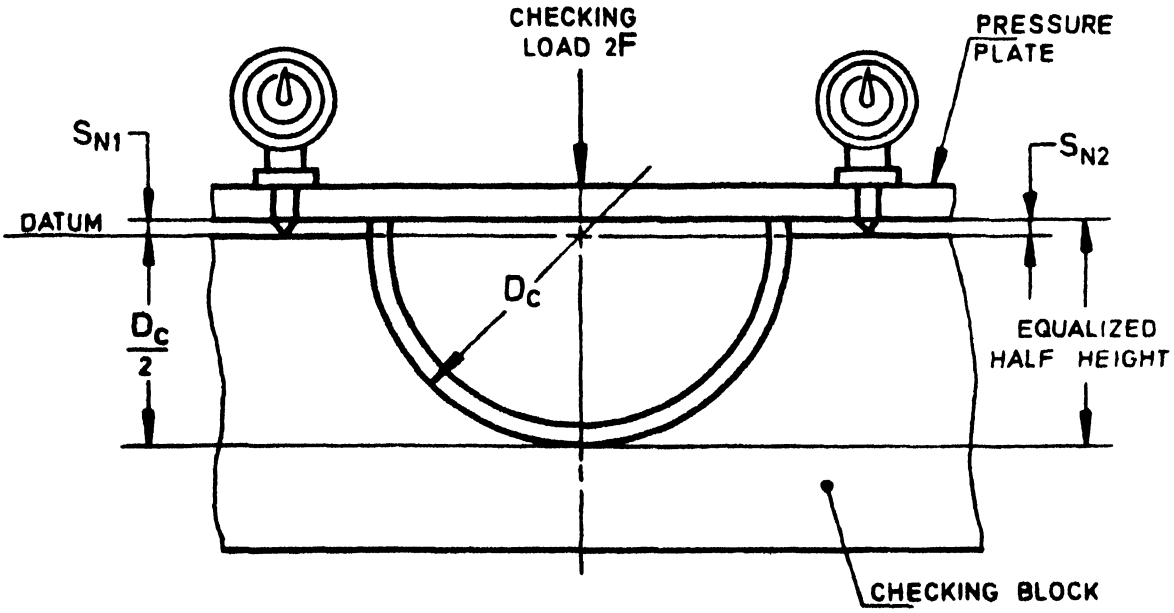
5.6 *Chamfers* — If machined chamfers are required, these shall generally be 45° or as agreed to between the purchaser and the manufacturer. Otherwise, all sharp edges shall be free of burrs. Inner diameter chamfer and outer diameter chamfer on end shall allow 0.3 mm minimum flat on bearing end face.

6. Method of Checking Peripheral Length

6.1 When checking the peripheral length of bearings, a typical fixture as shown in Fig. 8 is usually used with the inside diameter, D_C, of the checking block equal to the maximum housing diameter of the bearing. The tolerance limit for the checking block, D_C, shall be H2 grade of IS : 919 (Part I)-1963.



8A Checking Fixture Using A Single Fixed Stop



8B Checking Fixture Without Fixed Stop

(Where $S_{N1} + S_{N2} = S_N$)

FIG. 8 FIXTURE FOR CHECKING BEARING PERIPHERAL LENGTH

6.2 *Checking Load* — When checking the peripheral length of bearings, the following checking load F shall be applied to steel-backed half bearings:

$$F = 100 \times L \times e_T$$

where

F is the checking load, in Newtons;

L is the nominal bearing width in mm; and

e_T is the nominal bearing wall thickness in mm.

Note 1 — The checking load F shall be rounded to the nearest 500 N.

Note 2 — The checking load is limited to a maximum of 100 000 N but may be reduced according to fixture used. In this case, e_T shall be determined as per IS : 4774 (Part II)-1982 'Thin-walled half bearings: Part II Flanged bearing (*first revision*)'.

Note 3 — For backing materials other than steel, and for mono-metal bearings, the checking load is to be agreed between the purchaser and the manufacturer.

7. Manufacture — The bearings, being thin, depend entirely on housings for their precise shape and size under load. Housings shall be rigid, and precisely and smoothly finished. The following is a recommended sequence of operations for producing geometrically accurate bearing housings:

a) Bore, leaving enough material for a light cut for later finishing to size;

b) Remove bearing caps and machine all notches, grooves, etc;

c) Reassemble bearing caps to the same tightness as when finally fitting bearings; and

d) Finish bore or grind to size. This shall be the final machining operation. Grooving in the housing behind the bearing is not recommended unless the bearing bore is also grooved.

8. Designation — The bearings shall be designated by preferred housing diameter D_L and wall thickness and bearing lining material suffix number given in this standard.

8.1 A letter, indicating special features of the bearing, lining material shall be suffixed to the designation in the following cases:

Lining Material	*Suffix*
White metal, tin-based	WM
White metal, lead-based	WML
Copper-based alloy (unplated)	CL
Copper-based alloy (plated)	CL (P)
Aluminium-based alloy (unplated)	AL
Aluminium-based alloy (plated)	AL (P)
Any other material	SP (to denote material other than the above)

Example:

A thin-walled half bearing having housing diameter 32 mm and wall thickness 2 mm, using bearing lining as aluminium-based alloy (unplated) shall be designated as:

Thin-walled Half Bearings 32 — 2 A

9. Marking — The bearings shall be clearly and indelibly marked with the preferred housing diameters and wall thickness away from the crown of the bearing and as near to the joint faces as is practicable. The manufacturer's trade-mark or symbol together with the customer's part number, if required, may also be marked on the back of the liner. The marking shall not interfere, through burring or distortion, with the press fit of the running clearance.

9.1 In case of undersize bearings, the reduction shall be clearly and indelibly marked close to the designation on the bearing half-liner in hundredth of millimetres in the following manner:

	0.25	0.50	0.75	1.00	1.25	etc
Alternatively,	RS I	RS II	RS III	RS IV	RS V	etc

where 'RS' represents repair size.

9.2 *ISI Certification Marking* — Details available with the Indian Standards Institution.

10. Packing — The bearings shall be flashed with tin, lead-tin or lead-indium, wherever possible, and coated with anti-corrosive grease or oil. The packaging shall be subject to the agreement between the purchaser and the supplier.

APPENDIX A

(*Clause* 2)

COMPOSITION OF LINING MATERIALS

Lining	Approximate Percentage of					
	Sn	Sb	Cu	Pb	As	
1) *Tin-based White Metal*						
a) Sn Sb8 Cu4	88-90	7-8	3-4	0.35 *Max*	0.1 *Max*	
2) *Lead-based White Metal*						
a) Pb Sb10 Sn6	5-7	9-11	0.7 *Max*	80-86	0.25 *Max*	
b) Pb Sb15 Sn10	9-11	14-16	0.7 *Max*	71-77	0.6 *Max*	
c) Pb Sb15 Sn As	0.9-1.7	13.5-15.5	0.7 *Max*	80-84	0.8-1.2	
3) *Copper-based Alloys*						
a) Cu Pb 30	0.5 *Max*	—	*R	26-33	—	
b) Cu Pb24 Sn4	3-4.5	—	*R	19-27	—	
c) Cu Pb24 Sn	0.6-2.0	—	*R	14-27	—	
d) Cu Pb8 Sn4	3.5-4.5	—	*R	7-9	—	
4) *Aluminium-based Alloys*	Al	Cu	Sn	Ni	Si	Mn
a) Al Sn20 Cu	*R	0.7-1.3	17.5-22.5	0.1 *Max*	0.7† *Max*	0.7† *Max*
b) Al Sn6 Cu	*R	0.7-1.3	5.5-7	1.3	0.7† *Max*	0.7† *Max*
5) *Overlay*	Pb	Sn	Cu			
a) Pb Sn10	*R	8-12	—			
b) Pb Sn10 Cu2	*R	8-12	1.3			

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*R — Remainder.

†Total Si + Fe + Mn not to exceed 1 percent.

APPENDIX B

(*Clause* 2)

REQUIREMENT OF STEEL BACKING MATERIAL

1. *For Aluminium-based and White-Metal Alloys*

Cold rolled, bright annealed and free from surface defects, such as pits, rokes, laps and internal laminations.

Chemical Analysis		*Percentage*
Carbon	(C)	0.12 *Max*
Manganese	(Mn)	0.5 *Max*
Silicon	(Si)	0.35 *Max*
Sulphur	(S)	0.05 *Max*
Phosphorus	(P)	0.05 *Max*
		Range
Hardness		100 - 120 HV10

2. *For Copper-based Alloys*

Cold rolled and free from surface defects, such as pits, rokes, laps and internal laminations.

Chemical Analysis		*Percentage*
Carbon	(C)	0.15 *Max*
Manganese	(Mn)	0.7 *Max*
Silicon	(Si)	0.35 *Max*
Sulphur	(S)	0.05 *Max*
Phosphorus	(P)	0.05 *Max*
		Range
Hardness		170 - 210 HV10

EXPLANATORY NOTE

This standard was earlier prepared by Rolling Bearing Sectional Committee, EDC 39 in 1968. Consequently, on setting up of the Plain Bearing Sectional Committee, EDC 80, this subject was transferred from EDC 39 to EDC 80. This committee then felt the need of revising this specification to be in line with current international practices.

The revised standard covers the range for thin-walled half bearings for housings having inside diameter from 20 to 200 mm for plain bearings. Requirements of flanged bearings will be covered in a separate standard. Similarly, requirements pertaining to thrust half washers, which were earlier part of this standard, have been covered in a separate standard. For glossary of terms, definitions and classification, another separate standard is under preparation.

It is not expected that all the sizes listed in this standard will be available, but adoption of standard sizes should be economical in long run. For each housing size to be used, this standard recommends a range of wall thicknesses in order to permit a choice of shaft size that may accommodate the detailed design features necessary for the application under consideration.

This standard generally conforms to ISO 3548-1978, 'Plain bearings — thin-walled half bearings — dimensions, tolerances and methods of checking' issued by the International Organization for Standardization (ISO).

This edition 2.1 incorporates Amendment No. 1 (February 1996). Side bar indicates modification of the text as the result of incorporation of the amendment.